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Roberts et al.

[11] **4,439,952**

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[54] **PORTABLE GRINDER ASSEMBLY**

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[52] **U.S. Cl.** ..... **51/93;** 51/224; 51/231; 51/240 R; 51/266; 51/269; 144/134 A; 144/134 R; 144/242 R

[58] **Field of Search** ..... 51/92 R, 92 BS, 93, 51/122, 134.5 F, 170 PT, 224, 231, 240 R, 240 A, 266, 268, 269; 144/134 R, 134 A, 134 D, 242 R; 409/134, 163, 164, 168, 224; 269/73, 71, 285; 83/398

[56] **References Cited**

U.S. PATENT DOCUMENTS

587,537	8/1897	Van Norman	51/240 A
1,211,381	1/1917	Alden	51/93 X
1,216,600	2/1917	Paschall .	
1,390,726	9/1921	Scheiwer et al.	51/92 R
1,771,023	7/1930	Allen .	
1,783,618	12/1930	Hoyt	51/92 R
2,002,938	5/1935	Damser et al.	51/240 R
2,189,015	2/1940	Maurer	51/92 R
2,393,463	1/1946	Gottlieb	51/170 PT X
2,464,297	3/1949	Ertl	90/12
2,578,531	12/1951	Flanders et al.	51/84
2,714,337	8/1955	Schultz	51/240 A
2,839,969	6/1958	Anderson	90/59
2,881,834	4/1959	Thumim	83/898 X
3,463,137	8/1969	Hare	125/35
3,593,459	7/1971	Kulischenko	51/8
3,849,857	11/1974	Murray, Jr.	29/200 P
3,901,295	8/1975	Downing	144/134 A X
4,033,569	7/1977	Dunn	269/26
4,128,929	12/1978	DeMusis	29/156.8 B

FOREIGN PATENT DOCUMENTS

2046637	3/1972	Fed. Rep. of Germany	51/268
289980	11/1931	Italy	51/92

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[57] **ABSTRACT**

A portable grinder assembly for use in grinding oversized replacement stator vanes having a high speed air driven rotary carbide cutter situated adjacent a vane support. The vane support is capable of moving the vane in three predetermined directions with respect to the cutter. A tubular guard surrounds the cutter and not only directs cooling air on the cutter and vane during the grinding operation but also protects the operator of the grinder assembly from injury.

2 Claims, 3 Drawing Figures

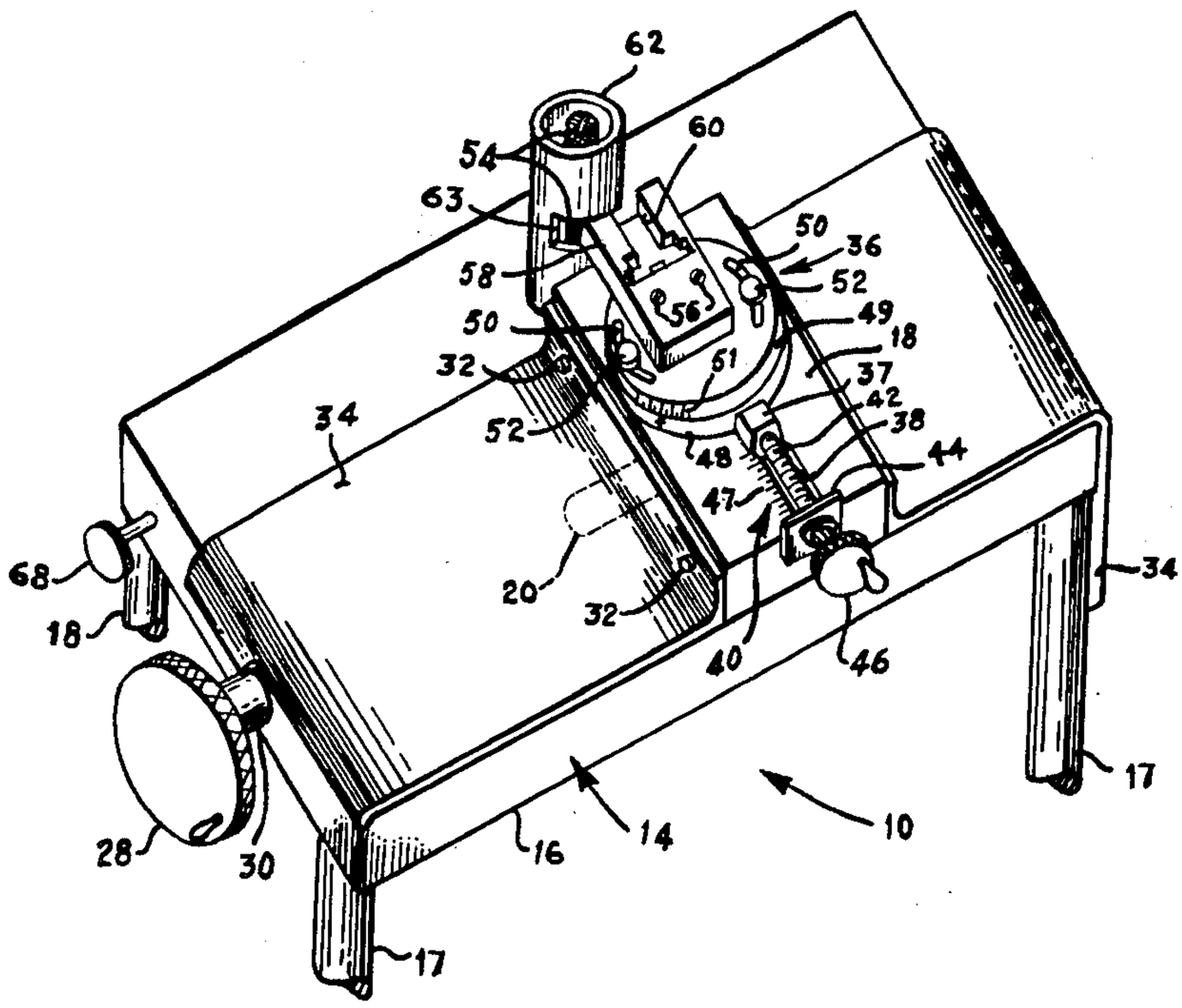

FIG. 1

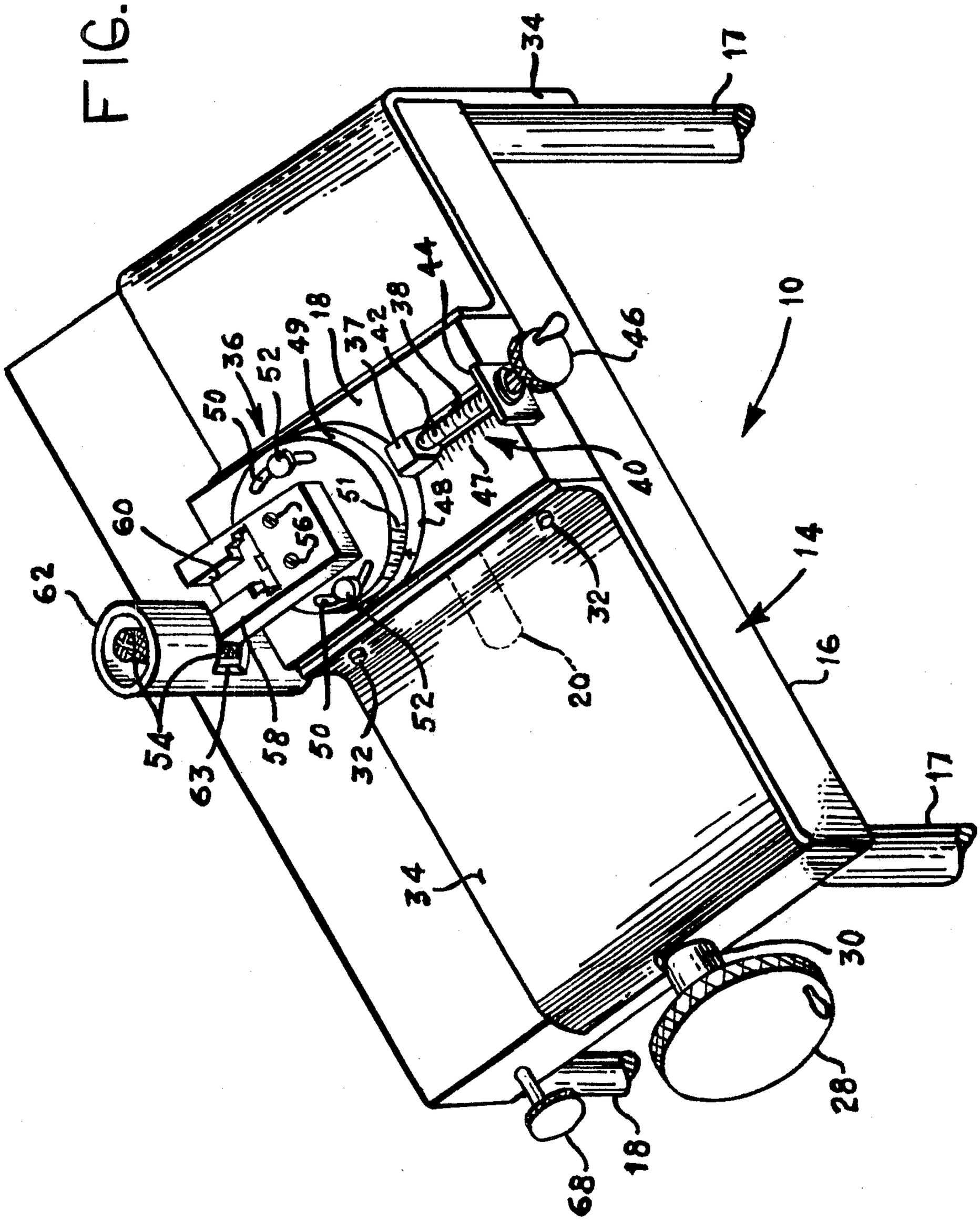
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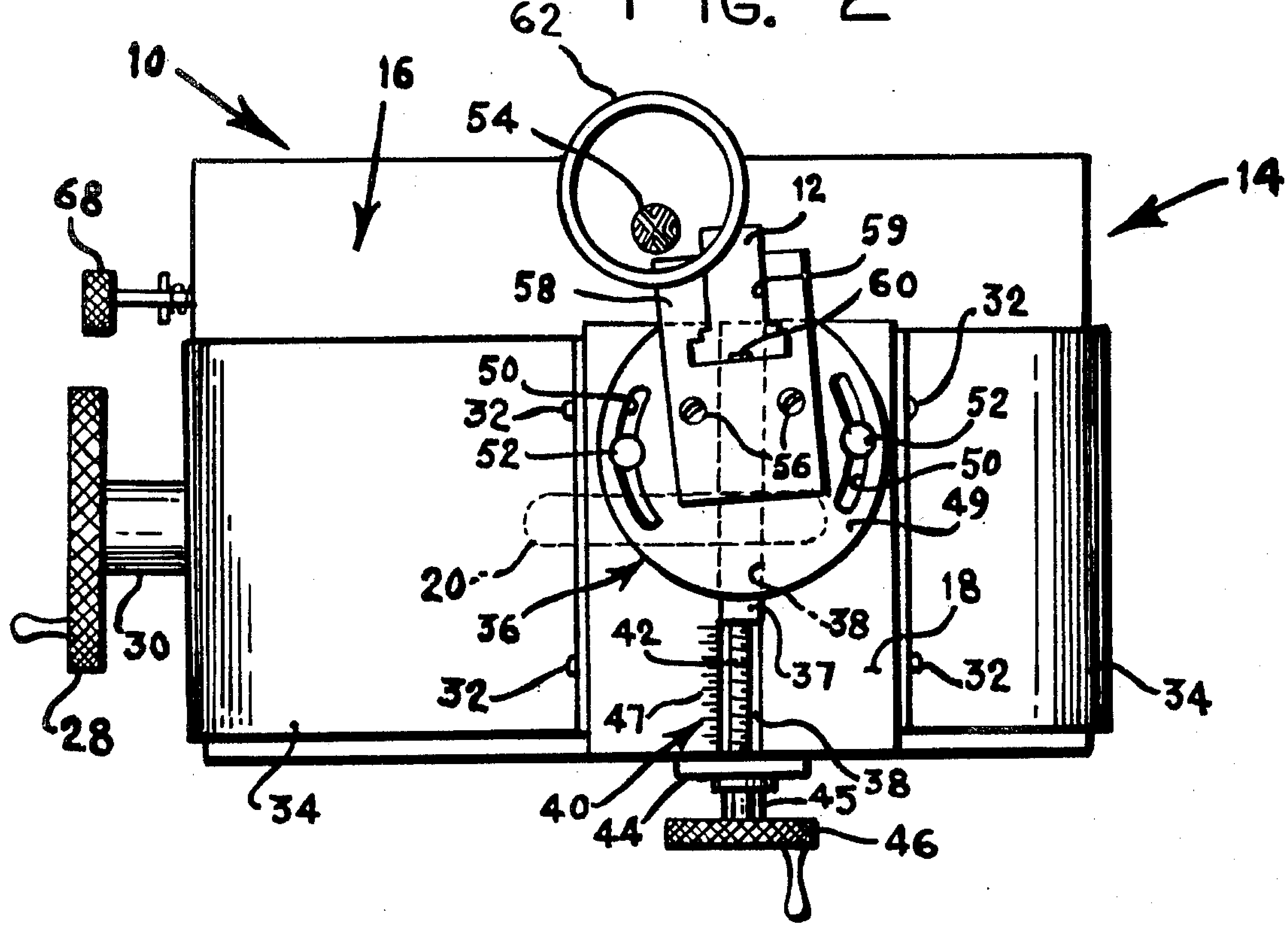
FIG. 2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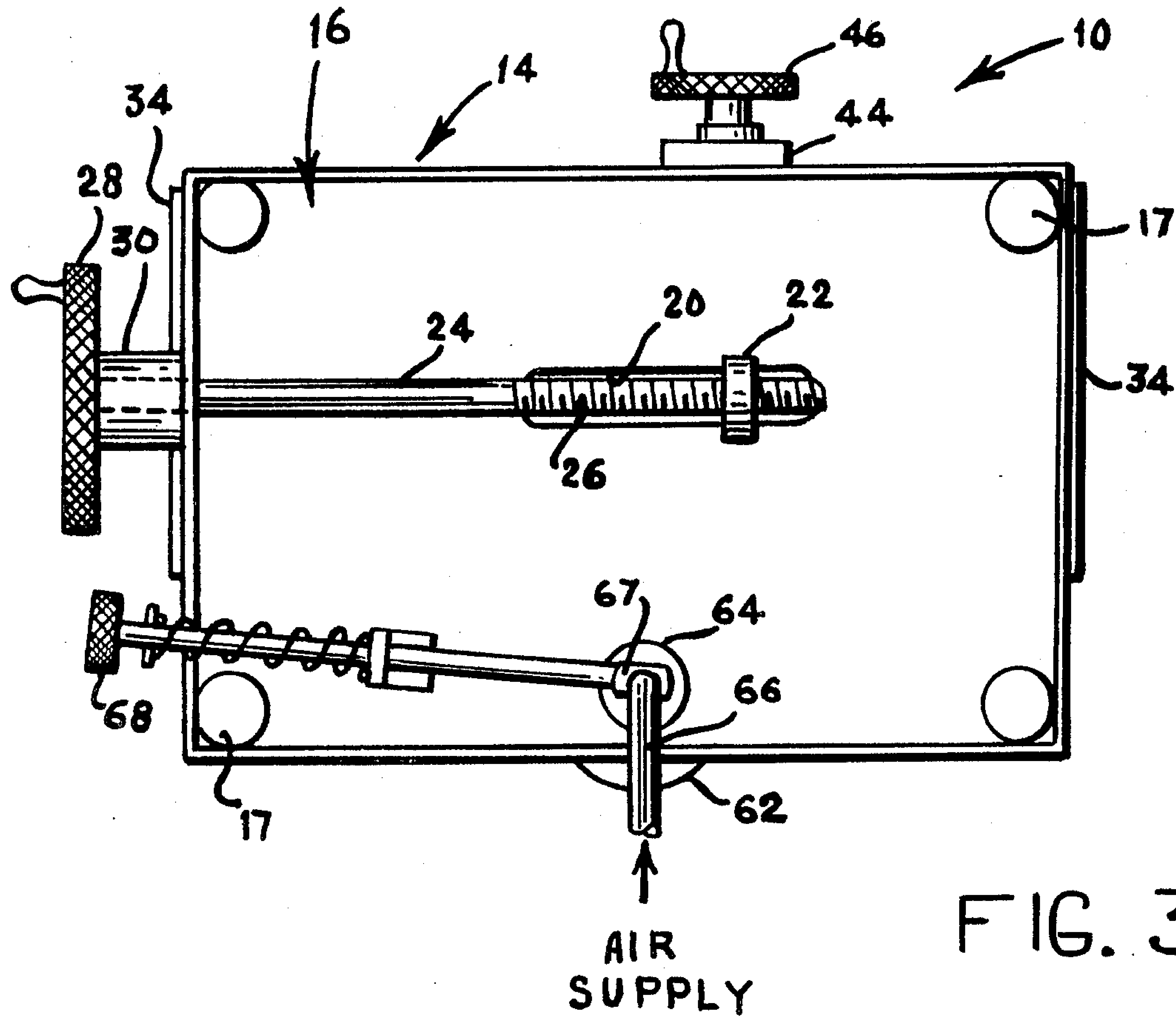
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AIR
SUPPLY

FIG. 3

PORTABLE GRINDER ASSEMBLY

STATEMENT OF GOVERNMENT INTEREST

BACKGROUND OF THE INVENTION

This invention relates generally to the refurbishing of worn turbine components, and, more particularly to a portable grinder assembly for grinding replacement stator vanes to a particular angle.

A major component of turbine engines are the radially extending circularly arranged stator vanes. These circularly arranged stator vanes are supported at their outer ends by an air seal ring and at their inner ends by a suitable hub. Unfortunately, after a period of operation, the vanes utilized in turbine engines such as, for example, the TF-39 engine, tend to become worn, especially in the vicinity of the trailing edge of the airfoil surface.

In the past, the replacement vanes were sized to the appropriate dimensions by either filing by hand or the utilization of milling machines or belt sanders. As is quite evident, utilizing such techniques when replacing a large number of stator vanes (480 per engine) the above approaches prove to be extremely time consuming, tedious and in many instances unreliable. For example, the milling machine approach tends to grab the stator vane and destroy it. The use of the belt sander is even more disappointing since the required accuracy is difficult to achieve and belts must be constantly changed.

Another method of restoring worn turbine components is set forth in U.S. Pat. No. 4,128,929 issued on Dec. 12, 1978. In the above-mentioned patent a complex series of fixtures are utilized in order to successfully restore the worn turbine components. Such a procedure also leaves much to be desired, especially when the replacement of worn stator vanes are being performed in the field.

It is therefore clearly evident from the above description of prior attempts at stator vane refurbishment, that a great need exists for a grinding device for utilization in stator vane replacement which is capable of being operational in the field, reliable, economical to produce and efficient in operation.

SUMMARY OF THE INVENTION

The present invention overcomes the problems encountered in the past and as set forth in detail hereinabove by providing a portable grinder assembly for grinding replacement stator vanes.

The grinder assembly of this invention incorporates therein an air driven carbide cutter used in conjunction with an adjustable stator vane holder. In addition, a uniquely designed enclosure for the cutter serves both as a safety shield and as a duct to ensure that cooling air surrounds the cutting surface during operation thereof. The utilization of the portable grinder assembly of this invention greatly facilitates the preparation of replacement stator vanes which must be ground to a particular angle depending upon their intended position within the turbine engine.

It is therefore an object of this invention to provide a grinder assembly for grinding stator vanes which is portable and therefore easily operational in the field.

It is another object of this invention to provide a portable grinder assembly which is easily operated and meets maximum safety standards.

It is a further object of this invention to provide a portable grinder assembly which greatly reduces the time involved in properly sizing the vanes.

It is still a further object of this invention to provide a portable grinder assembly which is economical to produce and which utilizes conventional, currently available components that lend themselves to standard mass producing manufacturing techniques.

For a better understanding of the present invention, together with other and further objects thereof, reference is made to the following description taken in conjunction with the accompanying drawing and its scope will be pointed out in the appended claims.

DETAILED DESCRIPTION OF THE DRAWING

FIG. **1** is a pictorial representation of the portable grinder assembly of this invention;

FIG. **2** is a plan view of the portable grinder assembly of this invention; and

FIG. **3** is a bottom view of the portable grinder assembly of this invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Reference is now made to FIGS. **1** and **2** of the drawing which clearly illustrate the major compenents of the portable grinder assembly **10** of this invention. It should be realized that although the following description will include therein specific reference to a replacement stator vane **12**, the grinder assembly is not limited to the grinding of stator vanes **12** but may be utilized, under certain circumstances, for the grinding of other types of elements.

As clearly illustrated in the drawing, assembly **10** is made up of a main support structure **14** which is preferably of a table-like or bench-like configuration having a substantially flat base **16** and a plurality of supporting legs **17**. Although this invention is not limited to specific dimensions, it should be realized that for the purpose of accommodating in-the-field operation support structure **14** should be dimensioned so that grinder assembly **10** may be portable.

Situated upon base **16** and slidable in the longitudinal direction thereon is a work mount **18**. Work mount **18** as clearly shown in FIGS. **1** and **3** of the drawing is positioned above a longitudinal slot **20** situated in base **16**. An internally threaded retainer **22** is secured to the bottom of mount **18** and protrudes through slot **20**. Retainer **22** is threadable upon an elongated rod **24** also having threads **26** at one end thereof and a suitable cranking element **28** at the other end thereof. Rod **24** is held in appropriate position with respect to base **18** by passing through a support block **30** either fixedly secured to base **16** or formed as an integral part. The appropriate rotation of crank **28** will therefore move mount **18** in the longitudinal direction with respect to base **16**.

Since grinder assembly **10** of this invention is used for cutting purposes, it is desirable to fixedly secure by any suitable fastening means such as bolts **32**, a pair of thin sheets or covers **34** to each side of mount **18**. The purpose of sheet cover **34**, which is preferably made of a

thin elastic material, is to preclude any of the grinding material or dust from falling through slot **20** and damaging the mechanism for moving mount **18**. As shown in FIG. **1** of the drawing sheet **34** may be made of such a length as to completely cover slot **20** when mount **18** moves to its fullest extent in either direction.

Slidably supported upon mount **18** for movement in a direction transverse to the longitudinal direction of slidable mount **18** is a two piece fixture holder **36**. Holder **36** has a guide **37** secured to or formed as an integral part of the bottom thereof. Guide **37** is slidable within a slot **38** located in mount **18** and positioned in a direction transverse to the direction of longitudinal slot **20**. Any suitable driving mechanism **40** capable of moving holder **36** in this transverse direction is operably connected at one end thereof to holder **36** and at the other end to mount **18**. As shown in the FIGS. of the drawing, a typical mechanism **40** which can be utilized for this purpose is a threaded rod **42** passing through a threaded aperture in guide **37** and being rotatably supported on mount **18** in any conventional manner such as by element **44**. A crank **46** is attached to end **45** of rod **42** so that rotation thereof causes this transverse movement of holder **36** to take place. Any suitable scale **47** can be marked adjacent mechanism **40** so one can quickly and accurately determine the amount of movement of holder **36**.

As shown in FIG. **1**, holder **36** is made preferably of two cylindrically-shaped elements **48** and **49** slidably rotatable with respect to each other. Element **49** has a pair of semi-circular slots **50** positioned therein about the central axis thereof with any suitable holding means such as bolts **52** protruding therethrough and being securable at the ends therof to element **48**. In this manner loosening of bolts **52** will allow manual rotation of element **49** with respect to element **48** to be performed so as to accurately position a stator vane **12** adjuacent a cutter **54** in a manner to be described in detail hereinbelow. A scale **51** can be utilized in conjunction with elements **48** and **49** in order to record the angular rotation of element **44**.

Removably secured by any suitable securing means such as bolts **56** to element **49** of holder **36** is stator vane fixture **58**. Fixture **58** has a cut-out portion **59** therein which is configured to accommodate stator vane **12**. A variety of fixtures **58** may be used with holder **36** so that a plurality of differently shaped vanes may be ground by this invention. Any suitable Allen-type screw or other holding means **60** is adjustably mounted in fixture **58** and located adjacent vane **12** when in place in order to securely hold stator vane **12** in position for grinding.

Adjacent fixture **58** and secured to base **18** is a cylindrically-shaped housing **62** which encompasses therein cutter **54** to be described further below. A slot **63** is formed in housing **62** adjacent fixture **58** so that stator vane **12** can contact cutter **54** as fixture **58** passes adjacent cutter **54**. The movement of stator vane **12** across cutter **54** is accomplished by the rotation of crank **28** thereby sliding mount **18** in the longitudinal direction adjacent cutter **54**. Cutter **54** is preferably a half inch diameter carbide cutter which protrudes through an opening in base **16** so as to be conveniently powered by any suitable air driven grinder **64** (shown in FIG. **3**) such as model 8212B manufactured by the Aro Corporation of Bryan, Ohio. Any suitable air supply may be attached to air inlet **66** for operating air grinder **64**. Housing **62** which encompasses cutter **54** not only serves as a safety shield during grinding of stator vane **12** but also acts as a duct to ensure that cooling air bathes the cutting surface during the grinding operation. The operation of grinder **64** can be regulated by any suitable on/off switch **67** which is attached thereto and controlled by knob **68** mounted in any suitable manner to base **16**.

MODE OF OPERATION

The portable grinder assembly **10** of this invention can be brought to the appropriate field position when it is necessary to replace worn stator vanes **12** from a turbine engine. Standard oversized stator vanes **12** which are readily available can be accurately ground to the appropriate dimensions by the use of this invention. An oversized vane **12** is positioned within cutout portion **60** in fixture **58** and fixedly secured therein by means of screw **60** with the mount **18** in a position removed from cutter **54**. Thereafter appropriate adjustment of cranks **28** and **46** positions vane **12** so as to come in contact with the cutter **54**. The specific angle of cut is determined by the amount of rotation between elements **48** and **49** of fixture holder **36**. The amount of material to be removed from vane **12** is determined by the position of holder **36** with respect to cutter **54** as determined by the rotation of crank **46**. Grinder **64** is activated by means of on/off knob **68** and the stator vane is slowly drawn across cutter **54** by the rotation of crank **28**. This operation can be performed manually and may be stopped at anytime during the operation to check for the accuracy of the cut.

With the utilization of the portable grinder assembly **10** of this invention stator vane repair can be made quickly, in-the-field and in an extremely accurate manner. The grinding of one stator vane by the use of the present invention can be accurately completed in approximately two minutes time. Such an operation is a substantial improvement over devices which have been used in the past.

Although this invention has been described with reference to a particular embodiment, it will be understood that this invention is also capable of further and other embodiments within the spirit and scope of the appended claims.

We claim:

1. A portable grinder assembly for use in grinding a component to a preselected size, said grinder assembly comprising:

a main support;

means operably connected to said main support for grinding said component, said grinding means including a vertically upstanding grinding element and air powered means for rotating said grinding element about is vertical axis;

means slidably mounted on said main support for positioning said component adjacent said grinding element and for permitting said component to be moved in three predetermined directions, said component positioning means including a fixture, said fixture containing a cut-out portion therein configured to accept an end of said component and for removably securing said component therein, first means connected to said fixture for permitting movement of said component to take place in a first predetermined direction and a second predetermined direction, and second means connected to said first movement permitting means for permitting movement of said component to take place in a third predetermined direction;

said first movement permitting means including a pair of elements, one of said elements being slidably mounted upon said second movement permitting means for permitting movement of said component to take place in said first predetermined direction and the other of said elements being slidably mounted upon said one element for permitting movement of said component to take place in said second predetermined direction;

said second movement permitting means being slidably mounted upon said main support for permitting movement of said component to take place in said third perdetermined direction and means operably connected to said second movement permitting means for moving said second movement permitting means a preselected distance;

said main support having an elongated, longitudinally extending slot formed therein adjacent said second movement permitting means, said means for moving said second movement permitting means having a portion thereof extending through said slot;

said second movement permitting means having means operably connected therewith for completely covering said slot in order to prevent grinding dust from entering said slot, said slot covering means including a pair of thin elastic sheets, each of said sheets being attached at one end thereof to said second movement permitting means, and each of said sheets simultaneously, continuously, completely covering said slot;

means encompassing said grinding element for cooling said component and said grinding element and protecting an operator of said grinder assembly from injury during operation thereof, said cooling and protecting means including an upstanding, cylindrically-shaped tube surrounding said vertically upstanding grinding element, said tube having a slot therein permitting said component to pass therethrough adjacent said grinding element; and

wherein said first predetermined direction is along a line transverse to said longitudinally extending slot, said second predetermined direction is about an axis perpendicular to the surface of said main support, and said third predetermined direction is along a line coincidential with said longitudinally extending slot.

2. A portable grinder assembly as defined in claim 1 wherein said component is made up of an oversized replacement stator vane.

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